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Abstract

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INSTRUCTIONAL OBJECTIVES FOR A JUNIOR COLLEGE COURSE IN CHEMISTRY (FIRST SEMESTER)

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CHEMISTRY OBJECTIVES: SET# 1

SPECIFIC COURSE AND UNIT OBJECTIVES

Expected Performance: Enrollment in this course is determined by satisfactory performance on a qualifying examination or by special consent of the instructor. Therefore, it is hoped only qualified students will enroll.

By midsemester (probably after the first hour examination) 35-40% of those enrolled are expected to drop the course. Of those that remain, a high level of performance is is anticipated: 70% on the hour examinations. Of those that complete the course, 75% are expected to meet 70% of the objectives. These students will receive grades of "C" or higher; they are qualified to continue further study in chemistry. Another 10-15% of the class will probably receive passing grades; it will be recommended that they do not continue further academic study in chemistry.

The objectives below are stated in terms of minimum achievement for those that desire to continue further study in chemistry. A higher level of performance would entitle a student to a grade of "A" or "B". Minimum achievement is associated with a grade of "C". Poorer performance will be graded below "C".

Except where noted, all objectives apply to both the lecture and lab. Unless otherwise stated, no accessory material is permitted during final assessment of objectives.

UNIT 1. Introduction and Review of Mathematics (4 lectures) (1 lab. expt.)

General objective: The student will receive an outline of the course. Objectives and minimum requirements will be discussed.

The student will gain an idea of the concepts, methods of investigation, nomenclature, and units of measurement used in chemistry and in science in general. He will review the mathematical operations needed in the course.

a. Given a list of definitions, the student will match the following terms with their definitions: liquid, gas, solid, density, phase, element, compound, acid, base, catalyst, energy, calorie, qualitative, quantitative, temperature. (80% accuracy)

b. The student will give with 90% accuracy
   4 examples of physical properties of water
   4 examples of a chemical change

c. The student will state which phase exists in the following situations: (80% accuracy)
   1. a balloon half-filled with salt solution
   2. a bowl of punch containing 14 cherries, 2 slices of pineapple and a cake of ice.
   3. 2 pieces of Swiss cheese

UNIT 1. (continued)

d. In a short essay, the student will state how the electrolysis of water upholds the Law of Conservation of Energy. (70% accuracy)

e. The student will discuss critically the statement: When a theory has been tested repeatedly and found to be true, it becomes a law. (75% accuracy)

f. The student will state the number of significant figures in the following numbers: 10, 136. 136.2±0.1, 54325 (90% accuracy)

g. The student will calculate to the proper number of significant figures: (80% accuracy)
   1. the altitude of a mountain peak which is 6,742.3ft above a lake which has an elevation of 913feet.
   2. the area of a circle of radius 2.40cm
   3. the volume of a cube with edge 2.4cm

h. The student will express the following numbers as powers of 10 (90% accuracy)
   96.501, 0.0000005, 100million million, 100 million-millionths, 3, 500.

i. The student will add and subtract to the proper number of significant figures, the following operations. (80% accuracy)

$$\begin{array}{r} 2.06 \times 10^{32} \\ +\ 2.06 \times 10^{33} \\ \hline \end{array} \qquad \begin{array}{r} 2.06 \times 10^{32} \\ -1.06 \times 10^{34} \\ \hline \end{array} \qquad \begin{array}{r} 8.04 \times 10^{-9} \\ \hline 2.00 \times 10^{-23} \end{array}$$

j. The student will perform the following operations:
   $(1.23 \times 10^{-8})^2$; $(1.23 \times 10^{8})^3$; $(1.23 \times 10^{8})^{1/2}$

   $1.23 \times 10^{-8} / 1.23 \times 10^{5}$; $1.23 \times 10^{8} / 1.23 \times 10^{5}$

   (90% accuracy)

k. The student will take the log to the base 10 of the following numbers (90% accuracy)

   10,000; 0.01; 645; 5.7; 0.000036

l. The student will take the anti-log of the following numbers (80% accuracy)
   8.50; 3.44; 1; 1.23; 0.342

m. The student will express the following temperatures in °C and °K.
   35°F; 200°F; -10°F; 250°F; -40°F (80% accuracy)

n. The student will express the following temperatures in °F.
   5°C; 5°K; 200°K; 2000°C; -50°C 1°K

o. The student will learn how to use the analytical balance (100% eventual

UNIT 2. Atomic and Molecular Theory. The Periodic Table (8 lectures)
(3 lab. expts)

General Objective: The student will gain a knowledge and understanding of the Laws of Chemical Change and the nature of matter in terms of the Atomic Theory.

Specific Objectives:

a. The student will state the 5 postulates that Dalton made in proposing his atomic theory. (80% accuracy)

b. The student with state how Dalton's atomic theory explains the
Law of Definite composition
Law of Multiple Proportions (80% accuracy)

c. The student will define the distinction between:
a gram; a gram-atom; an atom; a ton atom (80% accuracy)

d. The student will list in order of increasing weight the following compounds (70% accuracy)

50g iron; 5 gram-atoms of nitrogen; 0.10 gram-atoms of silver; 1×10^{23} atoms of radium

e. The student will use the Law of DuLong and Petit and compute the atomic weight of an element in problems of the following type: (75% accuracy)

The element chromium has a specific heat of 0.122 cal. per degree per g. If 3.121g of chromium combines with oxygen to form 4.561g of oxide, what is the atomic weight of chromium?

f. The student will show his understanding of the Law of Multiple proportions by solving problems of the following type: (70% accuracy)

Elements A and B form 2 different compounds. In one, 0.579g of A is combined with 0.422g of B. in the other 0.119g of A is combined with 0.261g of B. Show that these data illustrate the Law of Multiple proportions.

Suppose element X combines with Z to give two different compounds. In compound I there is 8.0g of X combined with 19.0g of Z; compound II is 25% X and 75%Z by weight. Show how these data illustrate the Law of Multiple Proportions.

g. The student will show his understanding of the Law of Definite Composition by solving problems of the following type: (70% accuracy)

Silver chloride (AgCl) consists of 75.3%by weight of Ag and 24.7%Cl. If 17.80g of Ag is allowed to react with 5.47g of Cl, what weight of AgCl is formed? Show how this problem illustrates the law of definite compotisition

UNIT 2.

g. With 80% accuracy, the student will describe briefly how Rutherford's experiment caused rejection of the Thomson model. He will state the essentials of the Rutherford experiment, and the basic points included in the Thomson model of the atom.

i. The student will describe the qualitative information that can be learned from experiments with discharge tubes (that also have electric and magnetic fields surrounding them). (80% accuracy)

j. The student will explain how the experiments of Thomson and Millikan can be combined to give the mass of the electron. He will state briefly the experiment of Thomson, the experiment of Millikan and the results that each showed.) (80% accuracy)

k. The student will match the following terms with their proper definition (90% accuracy)

electron, proton, a.m.u., charge, neutron, mass number, line spectrum, dielectric constant

l. The student will draw probability distribution plots for location of an electron: (80% accuracy)
   1. probability of finding an electron in a region relative to its distance from the nucleus
   2. normal method of representing cloud of electrons
   3. fuzzy cloud charge picture of an electron and nucleus
   4. probability of finding ls electron at a distance r from the nucleus

m. The student will name the 4 characteristics needed to describe an electron in an atom (90% accuracy)

n. The student will describe the build-up of the first 11 atoms in the periodic table and show that the periodic law is a natural consequence of this law. (state shell, subshell etc) (80% accuracy)

o. Using the data given in a table, the student will make a graph showing the variation of ionization potential with atomic number. He will show how this graph illustrates the periodic law and account for the graph in terms of electronic configuration. (100% accuracy) Lab. (Same type of problem with atomic size)

p. Using his understanding of electronic configurations, the student will explain why Ca (Z=20) and Zn (Z=30) are not placed in the same subgroup even though each haw two electrons in the oter-most shell (80% accuracy)

q. The student will state the essential difference between an electrovalent bond and a covalent bond and give examples of each. He will also do this for polar bonds and non-polar bonds. (90% accuracy).

UNIT 2.

r. The student will state the essential difference between the molecular-orbital and the atomic-orbital descriptions of the water molecule (80% accuracy). (in a short essay).

s. The student will describe and account for the chemical bond formed when fluorine atoms (Z=9) combine to form a molecule. He will describe and account for the chemical bond formed when lithium (Z=3) reacts with oxygen (Z=8). (80% accuracy)

t. The student will show why donor-acceptor bonding can account for the formulation of the compound BaS_2 (formed from BaS + S) (70% accuracy) by drawing electronic structures and labelling them.

u. The student will define the term "electronegativity"; he will state the relation between electronegativity and polarity of bonds; and state where in a period and in a group atoms would be expected to have the greatest electronegativity. (80% accuracy)

v. The student will draw electronic structures for Cl_2; HCl; CCl_4; $BaCl_2$; CO; CO_2; C_2H_6; HCN; and show how saturation of valence concepts and the octet rule hold. (70% accuracy)

w. The student will demonstrate his understanding of resonance by drawing electronic formulae for the nitrate ion NO_3^-. (70% accuracy).

x. The student will be able to solve problems of the general type: (70% accuracy)

Given atoms A,B,C, and D in the same period with one, three, five, and seven valence electrons, respectively. (1) What will be the formula of the compound between A and D, between B and D, and between C and D? (2) Compare the electronegativity of A with that of D. Will the compound between A and D be ionic or covalent? Write the electronic formula of the compound (3) Write the electronic formula of the compound formed between C and D. (4) Which of these atoms might form a diatomic molecule? (5) Which of these four atoms has the highest and which has the lowest ionization potential?

UNIT 3. Stoichiometry (3 lectures; 2 laboratory experiments)

General Objectives: The student will be able to use weight relations in chemical formulas and chemical equations.

Specific Objectives:

a. The student will write the chemical symbols for the elements in the first two periods of the periodic table (100% accuracy).

b. Given the % composition of a compound the student will be able to compute the formula weight of a compound, and vice verse (75% accuracy).

UNIT 3.

c. The student will indicate his understanding of moles, gram atoms, formula weight and molecular weight by stating the number of atoms and molecules in the following compounds: (90% accuracy)

Li; LiCl; H_2O; Al_2O_3

and by stating the number of moles in the each of the following (80% accuracy)

1.40g of N_2;
92.0g of NO_2;
1.5×10^{21} molecules of N_2O
the amount of NH_3 that contains 0.69 gram-atom of H

d. The student, given the periodicic chart, will be able to use his understanding of the periodic table, oxidation number and valence and write the chemical formulae for the following compounds (90% accuracy)

Sodium sulfate, zinc sulfate, titanium oxide, sodium ammonium hydrogen phosphate

e. The student will write the 5 rules for assigning oxidation numbers Using these rules, he will assign oxidation numbers to chlorine in the following compounds: (80% accuracy)

NaCl; NaClO; $NaClO_2$; $NaClO_4$; $NaClO_3$

to manganese in the following compounds:

Na_2MnO_4; MnO_2; $NaMnO_4$; Mn_3O_4 Mn_2O_7

f. In the following equations the student will indicate (80% accuracy)

the substance oxidized
substance reduced
reducing agent
oxidizing agent

1. $2Ca + O_2 \text{-----} 2CaO$

2. $H_2 + 3Fe_2O_3 \text{---} H_2O + 2Fe_3O_4$

3. $2F_2 + O_2 \text{------} 2OF_2$

g. The will balance equations of the following type (80% accuracy)

1. $H_2\,(g) + V_2O_3(s) \text{------} VO\,(s) + H_2O\,(g)$

2. $MnO_4^- + H_2C_2O_4 + H^+ \text{-----} Mn^{++} + CO_2(g) + H_2O$

h. The student will combine his knowledge of chemistry and mathematical relationships and solve problems of the following type (70% accuracy

A molecule of a given compound contains six atoms of A and ten atoms of B. The weight of 0.25gram-atom of A is 23g. One atom of B weight 1.6×10^{-22}g. (1) What is the atomic weight of A? (2) What is the atomic weight of B? (3) What is the percentage composition by weight of the compound (4) What is the simplest formula of the compound? (5) What is the molecular formula of the compound? (6) What is the molecular weight of the compound? (7) What is weight of 3.0×10^{19} molecules of the compound?

UNIT 3.

i. The student will solve problems of the following type: (70% accuracy)

Balance the following

$$H_2C_2O_4\ (s) + KMnO_4(s) \text{-----} H_2O(g) + CO_2(g) + MnO(s) + KOH(s)$$

2. Show for this reaction that 9.00 g of $H_2C_2O_4$ is required to react with 6.32g. of $KMnO_4$ and that 8.80g. of CO_2 is formed in the process
3. Show that for this reaction that 9.00g. of $H_2C_2O_4$ represents 0.200 gram-equivalent of reducing agent and 6.32g. of $KMnO_4$ represents 0.200 gram-equivalent of oxidizing agent

j. The student will prepare a chemical compound (100% accuracy) Laboratory.

UNIT 4. Gases (4 Lectures; 2 laboratory Experiments)

General Objective: The student will be able to define terms used to describe gases; discuss the laws which summarize the behavior of gases; explain the theories that have been proposed to account for observations on the behavior of gases; solve problems dealing with the behavior of gases.

Specific Objectives:

a. The student will express Boyle's Law (90% accuracy)
in a short statement
graphically
mathematically (also state how equation may be solved for new volume of the gas)

b. The student will express Charles' Law (90% accuracy)
in a short statement
graphically
mathematically (also state how equation may be solved for for new volume of the gas)

c. The student will perform experiments that reveal the behavior of gases (100% accuracy)

d. The student will be able to solve problems of the following type that illustrate application of Boyle's and Charles' and Dalton's Law. (80% accuracy)

(1) Given that 2.0g. of an ideal gas occupies 8.5 liters at STP. What is its volume at 0^oC and a pressure of 84cm Hg?

(2) Given that 2.0g of an ideal gas occupies 8.4 liters at STP. What is its volume at 91^oC and a pressure of 84cm Hg?

(3) Given 4.80g. of O_2 gas and 2.80g. of N2 gas. Calculate for each of these samples:
the number of moles
the number of molecules
the number of atoms
the volume as an ideal gas at STP
the volume as an ideal gas at 38.9cm Hgpressure and 273°C.

e. The Student will set up a general equation combining Charles' and Boyle's law and solve for unknown quantities in problems of the following type: (70% accuracy)

In a particular experiment 0.0273 mole of O_2 gas is to be collected over water at 17°C and a barometer reading of 715mm Hg. What volume will be occupied by this oxygen assuming it is saturated with respect to water vapor? What volume would oxygen occupy if the temperature is increased 10°?

f. The student will use Avodagro's hypothesis, the equation of state and solve gas problems of the following type: (70% accuracy)

Simultaneously, 0.202g of H_2 gas and 0.80g of O_2 gas are injected into an empty box which has a volume of 2.24 liters and is kept at 273°C. What is the final pressure in the box? Suppose a spark is passed through the box so that the hydrogen and oxygen can react to form water by the reaction

$$2H_2(g) + O_2(g) \text{------} 2H_2O(g)$$

What will be the final pressure in the box if the volume and temperature are kept the same?

g. Given a series of statements regarding the Kinetic theory, the student will be able to identify which statements account for the following observations (75% accuracy)
Gases are miscible
Gases are easily compressible
Brownian Motion
The pressure exerted by a gas increases as its temperature increases
The rate of diffusion of gases is inversely proportional to their square root of their mass

h. The student will define critical temperature and convert the critical temperature of hydrogen into degrees Centigrade and degrees Fahrenheit (80% accuracy)

i. The student will state two sources of deviations of gases from ideal conditions and state under what conditions of pressure and/or temperature nonideality exists/in a short essay.

UNIT 4.

j. The student will be able to solve problems of the following type using his knowledge of kinetic theory: (60% accuracy)

Consider two samples of ideal gas in two different 1-liter containers. The pressure of the two samples is equal, but the temperature (in°K) of sample 1 is half that of sample 2. Compare the two quantitatively with respect to each of the following:

(1) number of molecules
(2) molecular speed
(3) number of collisions per second with the walls
(4) average kinetic energy per molecule
(5) effect of an average collision with the wall in producing the pressure found in the two containers.

UNIT 5. Other States of Matter; Liquids and Solids. (4 lectures)
Changes of State

General Objective: The student will gain a knowledge and understanding of the liquid, colloid and solid states of matter and relate their properties to each other and to the gaseous state. He will understand how LeChatelier's Principle can be used to explain the natural effect of heat and pressure upon a closed system.

Specific Objectives:

(a) The student will be able to use his understanding of states of matter and explain briefly the following situations: in terms of kinetic theory (60% accuracy)
Given a substance in the liquid and gaseous states in equilibrium at some temperature, compare the following properties for the liquid and gas phases: compressibility; rate of diffusion; average kinetic energy of molecules; potential energy of molecules.

(b) The student will explain in terms of attractive forces the following observations: (80% accuracy) (in writing).
Separate portions of chloroform and water at the same temperature are poured on each hand. Chloroform feels colder.

When a stream of air is bubbled through water, the water evaoporated faster.

c. The student will be able to solve problems of the following type: (70% accuracy)
The normal boiling point of liquid HCl is -84°C. At this temperature the vapor pressure of SO_2 is less than 10mmHg. Are the intermolecular attractions greater in liquid SO_2 or liquid HCl? Which should have the higher critical temperature?

UNIT 5.

d. The student will use mathematical applications of the properties of liquids and solve problems of the following type: (75% accuracy)

The density of liquid argon is 1.40 g. per ml at -186°C. If the argon atom is assumed to be a sphere of radium 1.54×10^{-8} cm., what percentage of liquid argon is apparently empty space?

Hints: compute # mole in 1ml; # molecules or atoms in 1ml; volume of 1 atom; total volume of all atoms; % liquid argon that is empty space

e. Given statements regarding kinetic theory, the student will select the correct statements to explain the following observations: (80% accuracy)

1. solids are essentially incompressible, whereas gases can be easily be compressed;
2. solids maintain their shape, but liquids flow
3. diffusion in solids is many times slower than in liquids or gases
4. solids cleave at characteristic angles.

f. The student will explain in terms of kinetic theory why crystals give a spot X-ry pattern but liquids do not: (90% accuracy) (in writing)

g. Given a list of different properties of a solid, the student will identify which of four types of solids each represents (80% accuracy)

h. The student will write a short essay stating why the purist prefers not to speak of the molecular weight of solid sodium chloride but uses the term formula weight instead.

i. The student will explain briefly why metallic solids conduct ionic solids do not. (90% accuracy)

j. The student will define the term colloidal suspension (90% accuracy) in writing

k. Given a set of definitions, the student will match the following terms with their proper definition (80% accuracy)
colloid; gel; sol; emulsion; aerosol; electrophoresis
and give an example of each.

l. The student will describe the relation between Tyndall effect and the decreased effectiveness of automobile headlights in a fog. He will state the main reason that fog headlights are usually yellow (NB yellow light is of longer wavelength than white light. (80% accuracy) in a short essay

m. The student will distinguish between Brownian Motion and the Tyndall effect in a short easay. (70% accuracy)

UNit 5.

n. Using his knowledge of the nature of molecules and their polarity & surface area, the student will list in order the cmpds. most strongly adsorbed on charcoal
O_2, CO_2, 2 (70% accuracy)

o. The student will uses his knowledge of mathematical principles and demonstrate for minself the amount of gas that can be adsorbed on 1.0gm of charcoal (Specific adsorption: 1000sq ft per gm in a problem of the following sort: (80% accuracy)
If a H_2S molecule takes up an area of 12sq A^o when adsorbed, what volume at STP of H_2S can be adsorbed on 1.0g of charcoal.

p. The student will state in writing the principle of LeChatelier (90% accuracy)

q. Using his understanding of LeChatelier's principle the student will explain in a short essay situations of the following type:
Ice is added to warm water in a well-insulated container at atmospheric pressure. The amount of ice in the mixture decreases for a time then remains constant. (Hint: first state the temperature of the final mixture. Tell what will happen to the temperature if the pressure on the ice-water mixture is greatly increased; to the ice.
(80% accuracy)

s. Using his knowledge of kinetic theory, the student will discuss the situation in objective "q" in a short essay. (Hint: compare qualitatively the 3 phases present with respect to: density of the phase; average kinetic energy of the molecules; average potential energy of the molecules; compressibility of the phase; ordering of the molecules; pressure of the water. (80% accuracy)

t. Using a phase diagram of water, the student will state the phase that occurs under the following conditions: gas, liquid, or solid (90% accuracy)
4.58mm 0.0098°
760mm 100°
300mm 50°
760mm -5°

u. In the following situations the student will predict the correct result (reaction proceed to the left
reaction proceeds to the right) using his knowledge of Le Chatelier's principle (80% accuracy)
1. Heat + $AgNO_3$(s)----- solution: endothermic rac ion

heat is added to the system
Ice is added to the system

UNIT 5.

u. (continued)

2. $H_2 + I_2$------ 2HI
Pressure is added to the system

3. $N_2 + 3H_2$------$2NH_3$
Pressure is increased
Pressure is decreased

UNIT 6. Solutions (8 lectures; 3 laboratory experiments)

General Objective: The student will gain a knowledge and understanding of solutions. He will be able to use mathematical concepts to explain properties of solutions cr: molal freezing point, elevation of molal molal boiling point, % dissociatio... He will be able to define the term neutralization and solve problems involving stoichiometry and oxidation-reduction.

Specific objectives:

a. The student will match the following words with their correct definitions: (80% accuracy)
alloy, solute, solvent, mole fraction, molarity, molality, normality, saturated, unsaturated, electrolyte

b. The student will use his understanding of sclutions and state in writing which conditions produce greater solubility:
sugar in water or sugar in alcohol
sugar in water or salt in water
gasoline in water or gasoline in alcohol
(90% accuracy)

c. The student will state which of the following solutions is most concentrated and list the others in decreasing order of concentration (90% accuracy)
4.00×10^{-4} mole of sugar $C_{12}H_{22}O_{11}$ and 5.00×10^{-2} mole of H_2O
0.25m sugar solution
1.00g of sugar per 10.00g of water

d. In a short essay the student will describe how one can prepare a saturated, unsaturated and supersaturated solution of potassium acetate (100% accuracy)

e. The student will classify the following compounds as electrolytes or non-electrolytes: (80% accuracy
HCl, acetic acid, sodium hydroxide, sucrose, ethyl alcohol, oxygen, acetone, ammonium hydroxide, mercurous chloride, sodium chloride

UNIT 6.

f. The student will be able to solve problems involving properties of solutions of the following type: (70% accuracy)

How can you account for the fact that the freezing point depression per mole of NaCl is greater in 0.001M NaCl solution than in 0.01m NaCl solution--short essay

In a 0.1m aqueous solution, the weak acid HX is 5.0% dissociated. Calculate the expected freezing point of this solution.

An automobile radiator is filled with 2.0gal of antifreeze and 8.0qu of water. How cold can it get before this radiator "freezes" (Assume the antifreeze to be nonelectrolyte ethylene glycol, $C_2H_6O_2$ having a density of 1.12g per ml. Assume water to have a density of 1.0g per ml. The molal freezing-point depression constant of water is 3.35°F. per mole per 1,000g of water.

g. The student will state in writing 3 chemical properties of acids, and three chemical properties of bases (100% accuracy)

h. The student will define in writing, using electronic symbols when necessary the terms acid and base: (80% accuracy)
in the most usual manner
in terms of the Bronsted-Lowry concepts } give an example
in terms of the Lewis structure of each

i. The student will classify the following acids as being either monobasic, dibasic, tribasic (90% accuracy)
H_2SO_4; HCl; HOAc; H_3PO_4 ; $H_2PO_4^-$;

j. The student will solve problems involving stoichiometry of solutions of the following types: (70% accuracy)

How many moles of sulfuric acid H_2SO_4 are in
1.96g.
0.196gram equivalents
0.300 liter of 0.50M H_2SO_4
0.300 liter of 0.50M H_2SO_4
neutralized by 0.196mole of NaOH dissolved in 196ml of water
neutralized by 25.0ml of 2.40×10^{-2}N $Ba(OH)_2$

Assuming complete dissociation, calculate the number of molesof positive and of negative ion in each of the following solutions
20.0ml of 0.10M NaCl
30.0ml of 0.30M $CaCl_2$
50.0ml of 0.20M $Ca(NO_3)_2$
When the three above samples are mixed, the final volume is 100.0ml Calculate the concentration f Na^+, Ca^{++}, Cl^-. and NO_3^- in the final solution

UNIT 6.

k. The student will solve oxidation reduction problems of the following type: (70% accuracy)

Complete and balance the equation for the following change in acidic solution:

$Cr_2O_7^{--} + Sn^{++} \text{ -------} Cr^{+3} + Sn^{+4}$

Calculate the number of moles; the number of gram-equivalents; the volume of 0.10M solution; the volume of 0.10M solution of $K_2Cr_2O_7$ required to just oxidize 75ml of 0.30M $SnCl_2$ by the above reaction.

UNIT 7. Chemical Equilibrium (9 lectures 3 laboratory experiments)

General Objective: The student will understand the concept of equilibrium. He will be able to solve problems involving Dissociation Constant and Ionization Constants and explain the results interms of Kinetic Theory.

Specific Objectives.

a. The student will use his understanding of equilibrium and kinetic theory to explain in writing, briefly the following situations: (75% accuracy)

$CO_2(g) + H_2(g) \text{ =====} CO(g) + H_2O \quad -10kcal$

the effect of a rise in temperature in terms of dissociation constant, the principle of LeChatelier and kinetics.

the effect of a riscof pressure in the same terms

b. The student will distinguish in writing between each of the following : (60% accuracy)

Law ofchemical equilibrium; mass-action expression, equilibrium constant

c. The student will demonstrate his understanding of equilibrium by expressing graphically the following situations: (60% accuracy)

$1A\ (g) + 1B\ (g) \text{ =======} 1C(g)$

The change of concentrations of A, B, C with time as equilibrium is approached when

one mole of A and one mole of B are simultaneously injected into an empty box

one moe ofC is injected into an empty box

one mole of A and two moles of B are simultaneously injected into an empty box.

d. The student will list in order of increasing completeness of reaction the following situations: (100% accuracy)
$K = 1$; $K = 10^{10}$; $K = 10^{-10}$

e. The student will solve equilibrium problems of the following type (70% accuracy)

At 986°C, the K for
$H_2(g) + CO_2(g) \rightleftharpoons H_2O(g) + CO(g)$
is 1.60

In several experiments the gases were mixed in initial concentrations (in moles per liter) as indicated below. In each of the cases, calculate the final equilibrium concentration of each component at 986°C
1. 0.50M H_2 and 0.50M CO_2
2. 0.50M H_2O and 0.50M CO
3. 0.50M each of H_2, CO_2, H_2O and CO.

f. The student will titrate acids and bases (100% accuracy) Laboratory and experiment with the use of indicators.

g. The student will determine the pH of the following solutions: (80% accuracy)
pure water; 0.50M HCl, 0.010M NaOH; 1.0×10^{-3}M NaCl;

h. The student will demonstrate his understand of dissociation constants by explaining briefly in writing the following situation: (80% accuracy)
Suppose that the acid HX is a weak electrolyte. What happens to the H^+ concentration of an HX solution if: water is added
gaseous HCl is added
solid NaX is added

i. The student will solve problems involving pH and K_{diss} of the following types: (60% accuracy)

Given that K_{diss} equals 4.0×10^{-9} for HX and 9.0×10^{-9} for HY. Which of the following solutions has the highest pH
1. a solution made by dissolving 0.10mole of NaX in 0.50liter of solution
2. a solution made by dissolving 0.10mole ofNaY in 0.50 liter of solution
3. a solution made by mixing 0.10mole of HX with 0.10mole ofNaOH in 0.20liter of solution
4. a solution made b mixing 0.10mole of HY with 0.10 mole of NaOH in 0.20liter of solution

UNIT 7.

i. continued—Problems involving Kdiss and pH

1. Calculate the concentration of H^+ in the solution made by adding 0.50mole of $NaC_2H_3O_2$ to 1.0 liter of 0.50M $HC_2H_3O_2$ to 1.0 liter of 0.50M $HC_2H_3O_2$ This solution is a buffer solution.

2. Calculate the H+ concentration after 0.050mole of HCl has been added to 1.0 liter of the buffer above

3. Calculate the H+ concentration after 0.050mole of NaOH has been added to 10 liter of the buffer in the first situation

Repeat the calculations in 2 and 3 for the addition to 1.0 liter of water to see what effect the buffering process has on the change of H+.

CHEMISTRY OBJECTIVES: SET # 2

I. ATOMIC NATURE OF MATTER

The concepts of matter and energy will be discussed including such topics as the laws of conservation of mass and energy, the states of matter, homogeneity and hetergeneity and purification. Dalton's Atomic Theory and the classical experimental laws that support it will also be studied.

Goal: the student will define and recognize examples of the states and classifications of matter

objective: The student will define the states of matter in terms of volume and shape 100

objective: Given a list of common substances, the student will select the correct classification of matter for was 80

80

objective: Given a list of the classifications of matter the student will note whether they are homogeneous or heterogeneous 80

Goal: The student will understand methods of purifying matter

objective: Given a list of purification techniques the student will define each in 50 words or less and give and example of each 90

Goal: The student will know the classical experimental laws supporting the Atomic Theory

objective: Given the definitions of the laws and the names of the laws the student will correctly match the name to the definition 80

II. THE MOLE CONCEPT AND EQUATION BALANCING

Perhaps the most basic stoichiometric concept is that of the mole. The mole concept is used in all chemical calculation and therefore must be carefully learned. Such terms as Avagadro's number, atomic and molecular weights, gram atoms and gram molecular volume must also be understood in terms of the mole concept.

The chemical equation is an important tool if properly written and balanced because it incidates the kinds and numbers of reactants used and products formed in a chemical reaction. The methods for writing correct chemical formulas and balancing equations will be discussed intthis unit.

Goal: The student will be able to write correct formulas and balance equations

objective: Given word equations the student will select the correct equation 80

Goal: The student will understand the mole concept

objective: The student will define the term mole in 25 words or less 100

objective: Given simple compounds, the student will calculate the molecular weights and select the correct answer 85

objective: Given various fractions of moles the student will either choose the correct weight in grams, the correct number of atoms or molecules or the correct volume occupied by that amount of material 70

III. CALCULATIONS FROM CHEMICAL EQUATIONS

From the balanced chemical equations the weights and volumes of the chemical species used or made in a reaction can be calculated. The following types of problems will be included : a) weight-weight problems; b) volume-weight problems; c) weight-volume problems and d) volume-volume problems.

Goal: The student will be able to solve simple stoichiometric problems

objective: Given a list of terms the student will select the correct definition of each 90

objective: Given a list of quantities (in terms of the number of atoms, gram atoms, gram molecular volumes etc.)the student will select the correct number of moles represented by that quantity 75

objective: Outside of class the student will solve 20 problems involving the following types of problems: a) weight-weight problems; b) volume-weight problems; c) weight-volumes problems and d) volume-volume problems. 80

IV GASES

Gases are the simpliest chemical systems. As such they have been extensively studied and described mathematically, physically and chemically. None of the simplicity of the gas system is found in those systems involving liquids and solids. For this reason a study of the gas system is a very useful one.

Goal: The student will be able to define the gas laws and make simple calculations involving them

objec tive: Given the name of the law, the student will select the correct definition of that law 90

objective: Outside of class the student will solve 20 problems involving the use of one or more of the gas laws 80

Goal: The student will understand the kinetic molecular theory

objective: Given a list of statements the student will select those that are contained in the kinetic molecular theory 80

objective: Given a list of statements about gases the student will note which are facts and which are assumptions 70

V. WHAT ARE ATOMS LIKE?

Atoms are composed of electrons, protons and neutrons. The protons and neutrons for the nucleus which is surrounded by a cloud of electrons. The classical experiments that were used to discover these elementary particles are excellent examples of the use of macroscopic properties to determine microscopic structure.

The unstable nucleus emitts particles to become more stable. This phenomenon, known as radioactive decay, is of great use to modern scientists.

Goal: The student will understand the conclusions made from the classical experiments involving the discovery of the elementary particles

objective: Given the experimental apparatus and a brief description of the experiment the student will select the correct experimental conclusions 75

Goal: The student will understand the concept of isotopes

objective: Given a list of properties the student will select those that apply to isotopes 80

Goal: The student will be able to write equations indicating the modes of radioactive decay

objective: Given the modes of radioactive decay the student will select the correct definition of each 90

objective: Given incomplete equations for radioactive decay the student will select the correct completion for the equation 75

objective: Outside of class the student will calculate the amount of energy released in the following nuclear reaction:

$$2_1H^2 \qquad {}_2He^4$$

Be sure the units of your answer are those of energy. 100

VI. ELECTRON SHELL STRUCTURE

Through the use of spectroscopic analysis the configuration of the electrons in the space surrounding the nucleus can be studied. Such concepts as the quantum number system, the configuration of the orbitals, the energy levels and their filling, the orbital geometry, the excited atom and ionization will be included in this unit.

Goal: The student will understand the rules for filling electron shells

objective: The student will match the orbital symbol with the orbital shape 100

objective: Given a list of electron shells and subshells the student will place them in ascending order in terms of energy 90

objective: Given the atomic number for an atom the student will select the correct electron configuration 80

Goal: The student will understand the concept of ionization

objective: Given various energy level transitions the student will select those which are allowed transitions 100

objective: Given a series of energy level transitions the student will select those which yield ions 90

objective: Given the electron configuration the student will select the most probable ion that would form 80

objective: Given the elec tron configuration of the atom and the ion the student will indicate whether the ion is positive or negative and indicate the magnitude of the charge 85

VII. THE PERIODIC TABLE

Mendeleev ordered the chemical elements in chart form according to their chemical properties. He included all those elements known at that time and left spaces for those elements as yet undiscovered. He predicted the properties of these undiscovered elements which have since been varified following their discovery.

The periodic table allows the prediction of the properties pf the elements and their compounds. Such perimeters as kernal change, ionization potential and electron affinity can be easily predicted. The study of the periodic table teaches the student about the similarities and differences among the elements.

Goal: The student will understand the relationships found in the periodic table of elements

objective: The student will select "periodic perimeters" from a given list of perimeters. 80

objective: Outside of class the student will write a list of at least 10 of ther periodic peoperties of Group I elements and at least 10 for those of Group VII. 90

objective: Given an element the student will select its correct period and group 90

VIII. HOW DO ATOMS INTERACT WITH ONE ANOTHER?

Only the electrons in the outermost shell of the atom are involved in chemical bonding. These bonds may be covalent (shared electrons) or ionic (transferred electrons), weak or strong. To enable the student to predict the types of bonds that will form between elements the electron dot formula methpd is used to depict the outer shell electrons.

Goal: The student will be able to write electron dot formulas

objective: Given the element the student will select the correct electron dot formula 90

objective: Given the electron dot formúlas the student will predict the type of ion that would form 90

objective: Given the electron dot formula and the atomic number the student will select the correct electrpn configuration 85

Goal: The student will be able to form molecules which contain ionic and/or covalent bonds

objective: Using the periodic table the student will select the correct type of bond for given molecules 80

objective: Given pairs of molecules the student will select the correct electron dot formulas that illustrate the formation of ionic bonds 80

objectiver Given formulas for covalently bonded molecules the student will write electron dot configuration for each 75

IX. WHAT ARE MOLECULES LIKE?

The molecular structure or architecture, if known. allows many of the chemical and physical properties of the molecule to be explained. Particularly in the area of organic chemistry (the chemistry of carbon containing compounds) the molecular structures are very important because more than one molecule can have the same molecular formula.

Goal: The student will understand isomerization

objective: Given pairs of isomers the student will select the type of isomerization illustrated 80

objectiver Given one isomer and the type pf isomerization the student will select the correct example 80

Goal: The student will be able to recognize simple organic functional groups

objective: Given a list of functional groups and a list of examples the student will correctly match them 80

objective: Given the molecular formula and type of compound the student will select the correct molecular structure 80

objective: Given the molecular structure the student will select the correct name for the compound 70

Goal: The student will be able to apply the techniques of structure writing to inorgani molecules

objective: Given the molecular formula for an inorganic compoun, the student will select the correct molecular structure 60

X. CHEMICAL EQUILIBRIUM AND KINETICS

The relationship of time to chemical reactions is a very important one since a reaction can occur very rapidly, as in an explosiion, or it can take weeks, as in the rusting of iron. The chemist must know how long a reaction will take and therfore must study chemical equilibria and kinetics.

Goal: The student will understand chemical equilibria

objective: Outside of class the student will solve 15 elementary problems ánvo'ving equilibrium constants and concentrations 80

Goal: The student will understand why reactions go to completion

objective: Given a list of reactions the student will select those that go to completion 80

objective: Given a list of reactions the student will select the reasnn why the reaction goes to completion 80

Goal: The student will understand the factors that influence the rate of a reaction

objective: Given a change in the reaction environment the student will select either increased or decreased to indicate the change in the reaction rate 90

objective: Given a chemical situation the student will selec t the method that would either increase or decrease the rate 80

XI. AQUEOUS CHEMICAL EQUILIBRIA

Water has been called the universal solvent and as such its study is important. Salts dissolved in water form acidic, basic or neutral solutions. The measurement and/or calculation of the pH indicates whether a solution is acidic, basic or neutral.

Goal: The student will be able to recognize acids, bases and salts.
- objective: Given a list of substances the student will indicate whether they are bases, acids, or salts 80
- objective: Given a list of acids and bases, the student will indicate the type of acid or base and the degree of ionizatoon
  ex: NaOH: strong base: completely ionized 75

Goal: The student will understand the use of pH and pOH
- objective: The student will define pH in 25 words or less and also define it mathematically 100
- objective: Given a list of pH's the student will indicate whether each is acid, bas or neutral 80
- objective: Given a list of pOH and pH the student will convert them to pH and pOH respectively. 80
- objective: The student will solve 10 problems involving the calculation of pH and pOH for solutions of strong acids and strong bases 80

Goal: The student will understand the solubility rules
- objective: Given a compound the student will indicate whether or not the compound is soluble in water

XII. MACROSCOPIC PROPERTIES AS DETERMINED BY MICROSCOPIC STRUCTURE

Many structural properties of solids can be deduced from the study of the macroscopic properties of the material, for example such properties as heat of fusion, melting point, hardness, brittleness, etc. These properties indicate the degree of order of the solid.

Goal: The student will understand the structure of the different types of crystals that form

objective: Given a molecule the student will indicate whether it will form an ionic, covalent or molecular crystal 70

objective: Given the data obtained from a crystal study the student will indicate whether it is an ionic, covalent or molecular crystal 80

objective: Given the types of crystals formed the student will select the correct properties for that type of crystal 80

XIII. CHEMISTRY IN INDUSTRY

Through chemistry products have been created that have changed our entire way of life. From plastics to jet fuels, chemists have used old molecules for new purposes or created new molecules for new purposes. The study of some of these products will give the student an introduction to the vast chemical industry in the United States today.

Goal: The student will understand the ways heavy chemicals and metals are produced, purified and used

objective: Given a list of heavy chemicals and metals the student will select the correct method of preparation 80

objective: Given a list of heavy chemicals and metals the student will select the correct uses of each chemical 80

Goal: The student will understand how petroleum products are purified, modified and used

objective: Given examples of petroleum products the student will indicate the size range of these molecules 90

objective: Given a list of refining processes the student will select an example of the use of the process 80

objective: Given a list of petroleum products and biproducts the student will select a use for each product 80

Goal: The student will understand the types of polymers used in plastic manufacturing

objective: Given examples of polymers the student will indicate the type of polymer illustrated 80

objective: Given the materials used to make a polymer the student will select the correct polymer formed from these materials 70

XIV. BIOMOLECULES AND BIOPOLYMERS

The study of the complex molecular assembly known as the cell incorporates many phases of chemistry, physics and biology. We are composed of cells and therefore the study of this system is of interest to every student. Topics such as how food is digested, what the "food" molecules are used for, what "food" molecules become in the cell, what hormones do, why cells require minerals, etc. are just a few of the possible areas of investigation in biochemistry and molecular biology.

Goal: The student will know the types of biomolecules and biopolymers

objective: Given a list of names of molecules that student will select the correct type of molecules represented by each 90

objective: Given the molecular formula or molecular structure the student will select the correct type of molecule represented by each 80

objective: Given the name of a molecule the student will select the correct molecular formula for that molecule 80

Goal: The student will understand how polymers are formed by the cell

objective: Given the building blocks of a polymer the student will select the correct polymer formed from these materials 80

objecttve: Given the name or structure of a biopolymer the student will select the funtion that molecules performs in the cell 80

Goal: The student will understand what ingested food substances become in the cell

objective: Given the type of molecule the student will select the correct substance formed in the cell 80

objective: Given the end product of a biological pathway the student will select the correct starting material 70

CHEMISTRY OBJECTIVES: # 3

V. Materials Of Instruction:

A. Required Texts And Manuals:

Text: Fundamentals Of College Chemistry, by Wood et Al, Harper And Row Publishers, 1966. Price $7.75

Laboratory Manual: Laboratory Manual For College Chemistry, Smith and Wood, 3rd Edition, Harper And Row Publishers, 1966.

VI - ORGANIZATION OF EACH CHAPTER OF INSTRUCTION

Chapter 1 : Some Physical Measurements

A. Goals:

(1) The students will become acquainted with and be able to apply The Metric System Of measurement.

(2) The students will become acquainted with the Centigrade and Fahrenheit Thermometers, be able to use them, and convert from one reading to the other.

(3) The student will know the definitions of certain key words in this chapter.

B. Specific Objectives:

(1) With the help of the metric system chart on the front wall and his notes, the student will answer 20 questions on a multiple choice and completion type test involving the use and conversion of units in the Metric System, in one hour, in class, with a base criterion of 70%.

(2) The student willidentify the type of thermometer used and read the temperature from a drawing on an examination and convert the reading to the other scale in 5 minutes in class, without notes, with a base criterion of 90%.

(3) The student will match the following words with the correct definition on a short test, in class, in 10 minutes, without notes with a base criterion of 70%: Density, Specific Gravity, Chemistry, Science, Matter, Energy, Hypothesis, theory, law, Temperature, Calorie,

C hapter II - Atomic Structure; Atomic Weights
Chapter 15; Electrons and Periodic Relationships

A. Goals:

1. The student will know the names and significance of the three component parts of any atom: the proton, the electron, and the neutron.

2. The student will know the atom according to Bohr and the arrangement of the three fundamental parts of the atom into a miniature solar system.

3. The student will know and understand how the atomic number determines the number of protons in the nucleus and the number of electrons which surround the nucleus in well defined energy levels or shells.

4. The student will know and understand the meaning of atomic weights and isotopes and what the standard is for atomic weights.

5. The student will know the orbital configuration for the first 20 elements.

B. Specific Objectives:

1. The student will draw the atomic picture of 5 of the first 20 elements shown on the periodic chart showing the arrangement of the three fundamental particles on a unit test covering chapters 1 thru 4.

2. Given the atomic number of five elements, the student will identify the number of neutrons in the nucleus on a unit test.

3. With the help of the periodic chart, the student will write the atomic weights of 5 elements to the nearest whole number using the prescribed rules as given in class as part of the unit test.

4. The student will indicate on a short answer item on a unit test the name of the element used as the first standard for atomic weights, the second element used, and the present element used.

CHAPTER 3 - How Atoms Combine; Compounds and Chemical Changes.

A. Goals:

1. The student will know and undcrstand how atoms combine to form molecules and ions

2. The students will know the classification of the three major type of elements and how they combine to form compounds.

3. The student will be able to apply the RULE OF EIGHT in the formation of compounds.

4. The s tudent will know the three main kinds of evidence which the cherist uses to determine whether or not substances react chemically when they are brought together.

B. Specific Objectives:

1. From a list of 11 materials, the student will indicate on a unit test whether each is an element(E), compound (C), or a mixture(M).

2. The student will draw electron dot symbols of what he thinks happens when one element combines with another element to form a compound. T is will be done on a unit test.

3. Given a list of 5 chemical and physical changes on a unit test, the student will choose which are chemical by encircling the proper number.

4. Given a list of 5 chemical reactions on a unit test, the student will indicate whether each is an endothermic or exothermic reaction.

CHAPTER 4 - Formulas and Equations; Classification Of Compounds.

A. Goals:

1. The student will know and be able to reproduce the latter Classification Chart developed bt the instructor during a lecture.

2. The student will understand the meaning of the terms: oxidation number, di-atomic molecule, formula, acids, bases, salts, electrovalency.

3. The student will be able to write formulas from a list of oxidation numbers given to the student as a hand-out.

4. The student will be able to write the names of compounds from their formulas.

5. The student will be able to write a simple chemical equation from paeticular information given to him.

6. The student will be able to determine whether a solution is an electrolyte or non-electrolyte.

B. Specific Objectives:

1. Given a list of elements, the student will write the formulas of six compounds as part of the unit test.

2. Given a list of ten terms, the student will define each by short answers on a unit test.

3. The student will reproduce the Matter Classification Chart on a pop quiz ,in class, in ten minutes with a criterion of 100%.

4. Given a list of six formulas, the student will name each on a unit test.

5. Given the names of five solutions on the unit test, the student will determine whether the solutions are electrolytes or non-electrolytes.

CHAPTER 5 - Weight Relationships From Formulas and Equations

A. Goals:

1. The stude t will know and understand and apply the mole concept in chemistry.

2. The student will be able to determine the molecular weight of any compound

3. The student will determine the %-composition of any compound from its formula.

4. The student will be able to determine the empirical formula and the true formula of a compound.

5. The student will be able to express the weight relationship inherent in a chemical equation and do problems involving weight relationships.

B. Specific Objectives:

1. The student will write the formula weight of six compounds on a unit test.

2. The student will calculate the %-comp of each element of a compound on a unit test.

3. The student will determine which of three compounds has the highest per cent of carbon on a unit test.

4. Given the analysis of a compound by %-comp, the student will derive the empirical formula of two compounds and the true formula of one of them on a unit test.

5. Given three word reactions, the student will write the equations and calculate the weight relationships on a unit test.

CHAPTER 6 - The Periodic Table

A. Goals:

1. The student will be acquainted with the anatomy of the Periodic Chart interms of horizontal rows and vertical columns.

2. The student will know and appreciate the significance of position or placement of any one element or family of elements on the chart.

3. The student will be able to apply his knowledge of the anatomy of the chart and the position of any element to a mock set-up of letters to the first three rows of the chart.

B. Specific Objectives:

1. Given the first three rows of a mock set-up of a periodic chart using letters in alphabetical order in place of the regular atomic symbols, the student will encircle the number in front of a list of 10 ficticious compounds which are correctly written on the unit test.

2. From the same ficticious chart on the unit test, the student will encircle the number in front of the ststements which are correct.

CHAPTER 8 - The Kinetic Theory Of Gases

A. Goals:

1. The student will know and understand the five essential points of The Kinetic Molecular Theory of Gases.

2. The student will know how gas pressure is measured, what standard conditions are and how to convert from one unit to another unit of measurement.

3. The student will be able to state and apply Boyle's and Charles' Laws.

B. Specific Objectives:

1. On a unit test , the student will state the five essential points of The Kinetic Molecular Theory.

2. Given a pressure measured in lb/in^2 , the student will convery this reading to the corresponding reading in inches of Mercury and millimeters of Hg, on a unit teat.

3. On a unit test, the student will indicate in a general way what happens to a certain volume of a gas if the pressure and temperature are altered individually.

CHAPTER 9 - Calculations Involving Gases

A. Goals:

1. The student will know the mathematical expression and apply the following gas laws: Boyle's Law, Charles' Law, Gay-Lussac's Law, and Dalton's Law Of Partial Pressures.

2. The student will state and understand and apply Avagadro's Law and Number.

3. The student will understand and apply volume-weight, and volume-volume relationships in chemical equations.

B. Specific Objectives:

1. On a unit test, the student willanswer 20 multiple choice items covering the gas laws listed in goal #1.

2. The student will answer two multipe choice items on a unit test concerning Avogadro' Law and Avogadro's number.

3. The student will answer three questions involving problems of volume- weight and volume-volume type on a unit test.

CHAPTER 10 - Water and Hydrogen Peroxide, The Liquid State

A. Goals:

1. The student will know and understand the physical properties of water, the structure of water molecules, and the chemical properties of water.

2. The s tudent will know and understa nd the definitions of the following terms: Hydrate, anhydrous, water of crystalization.

3. The student will know the composition of natural or normal water and also that of heavy water.

4. The student will know the structure, properties, and preparation of hydrogen peroxide.

5. The student will become acquainted with the following properties of water: shape and volume, compressibility, change of volume with temperature, diffusion, evaporation and solidification, boiling point, and critical temperature.

6. The student will realize why water is a very unusual liquid.

B. Specific Objectives:

1. On a unit test, the student will answer 15 questions of the short answer type concerning the physical and chemical properties of water, the definitions indicated in goal two above, the composition of natural and heavy water, the structure and preparation of hydrogen peroxide, and some unusual properties of water.

CHAPTER 11 - Solutions

A. Goals:

1. The student will review and know the place of solutions on the Matter Classification Chart developed in chapetr 4.

2. The student will know the definition of and anatomy of a solution; the factors which affect solubility, how to express the concentration of solutions; and the types of solutions.

3. The student will be able to do problems involving Molar solutions; titration of acids and bases; and molal solutions.

B. Specific Objectives:

1. The student will answer 17 multiple choice items derived from the goals on a unit test.

CHAPTER 12: Rates Of Reactions; Chemical Equilibrium

A. Goals:

1. The student w ill know the definition of the rate of reaction; understand and apply, the factors which influence reaction rates.

2. The student will know and apply the mathematical expression for the chemical equilibrium constant 'K'.

3. The student will know the factors which will introduce a stress into the equilibrium reaction and the effect produced according to LeChatelier's Principle.

B. Specific Objectives:

1. The student will answer 4 questions on a unit test of the multiple choice variety concerning the factors which influence reaction rates.

2. The student will write the mathematical expression 'K' for a chemical equation on the unit test.

3. The student will answer questions on the unit test regarding the affect of various stresses introduced into a particular eqation at equilibrium.

Chapter 13 - Ionic Equilibria

A. Goals:

1. The student will know and understand the general acid-base relationships; the strength of acids and bases; and the ionization of a weak acid.

2. The student will be able to apply the ionization constant expression to selected problems involving acids and bases.

3. The student will derive, know and apply the hydrogen ion concentration expression (pH)

B. Specific Objectives:

1. The student will answer 6 multiple choice items on a unit test concerning the application of the mathematical expression pH .

2. The student will solve aproblem on the unit test which involves the ionization constant (K) .

CHAPTER -16 Electrochemistry; Oxidation-Reduction

A. Goals:

1. The student will understand the principles of oxidation and reduction as they apply to a battery and an alectrolytic cell.

2. The student will determine what was oxidized and what was reduced in a chemical reaction.

3. The student will be able to balance a redox reaction using the $\frac{1}{2}$-reaction technique.

B. Specific Objectives:

1. The student will answer 8 multiple choice type questions on a unit test in the application of redox principles to an electrolytic cell and redox in general with stated conditions and criteria.

2. For a given reaction the student will indicate on the unit test: (a) What was oxidized and reduced; (b) the oxidation $\frac{1}{2}$ reaction; and (c). the reduction $\frac{1}{2}$ reaction.

3. Given a chemical reaction, the student will balance the reaction using any technique he wishes on the unit test.

CHAPTER 25 - Nuclear Chemistry

A. Goals:

1. The student will review and know the fundamental particles in the nucleus of an atom and apply that information to natural radioactivity, and be able to trace the transmutation of Radium to its end product lead.

2. The student will understand and apply the principle of $\frac{1}{2}$-life in radioactivity.

3. The student will learn how particles are accelerated and the devices for accelerating them.

4. The student will understand and apply Einstein' equation $e=mc^2$.

5. The student will understand what is meant by nuclear fission and nuclear fusion.

6. The student will know the construction and function of the nuclear reactor.

B. Specific Objectives:

1. The student will be given a series of particle emissions and asked to determine the final atom achieved in the decay process on the final examination.

2. Given the $\frac{1}{2}$-life of a particular atom, the student will determine the amount of thatnucleus has decayed in a certain length of time on the final examination.

3. The student will determine on the final examination what the result may be when a nucleus of Uranium is bombarded with a fast moving neutron.

4. Given the delta H for a particular nuclear disintegration, the student will determine by calculation using Einstein's equation , the mass loss of the original atom on the final examination,

5. The student will be asked to give an example of a fission and a fusion reaction on the final examination.

6. On a unit test, the student will be asked to match the parts of a nuclear reactor with their proper function.

CHAPTER 26 - Organic Chemistry I: The Hydrocarbons

A. Goals:

1. The student will become acquainted with the vast area of chemistry known as organic Chemistry.

2. The student will know the name, structural formula, molecular formula, and homologous series formula for the hydrocarbons of the alkane, alkene; alkyne, and benzene types.

B. Specific Objectives:

1. Given the names of 15 hydrocarbons, the student will write the molecular and structural formulas for each of them on the final examination.

2. Given the formulas for 5 hydrocarbons, the student will supply the correct name for each of them on the final examination.

CHAPTER 27 - Organic Chemistry II; Derivatives Of The Hydrocarbons.

A. Goals:

1. The students will review and know the prefixes and radicals pertinent to hydrcarbons.

2. The student will know the general formulas for: Alcohols Ethers, Aldehydes, Ketones, Organic acids, and Esters.

3. The student will know the specific formulas for the first three members of each calssification.

4. The student will be able to start with a particular alkane and be able to derive the corresponding alcohol, ether, ketone, organic acid, aldehyde, and ester.

B. Specific Objectives:

1. The student will be given the name of a lower alkane on the final examination and write the molecular and structural formula as well as the name of the corresponding derivative s in the blanks provided on the final examination.

CHEMISTRY OBJECTIVES: SET # 4

LESSON 1

Specific objective:

Given ten assorted dimensions, volumes, or masses, in class and without references the student will convert each into its corresponding English or metric counterpart, as the case may be, with at least 70% accuracy.

LESSONS 2 and 3

Specific objectives:

In class and without references, the student will...

(1) fill in blanks in order to complete a skeleton paragraph dealing with composition of atoms. Eighteen answers required, 70% correct to pass.

(2) write the names of at least five of the seven diatomic elements.

(3) correctly define in writing five words relating to composition of atoms or periodic law. (80%)

(4) predict in writing, given the atomic weight and atomic number of a hypothetical element, selected properties of this element on request. (100%)

LESSONS 4 and 5

Specific objectives:

In class and without references, the student will...

(1) correctly define in writing eight words relating to compounds and chemical bonding. (87.5%)
(2) write the correct formulae for twenty compounds whose names are given. (90%)
(3) correctly draw the bonding electron configurations of two covalent compounds on request. (100%)
(4) correctly name ten compounds whose formulae are given. (90%)
(5) write, upon despription of a sequence of three chemical changes, the correct balanced chemical equations. (100%)

LESSON 6

Specific objective:

In class and without references, the student will write short answers which identify or complete each of eight given phrases concerning oxygen and chemical energy.

LESSON 7

Specific objectives:

In class and without references, the student will...

(1) be able to write the correct formula weights for seven out of eight chemical compounds named.

(2) answer at least three of four questions which require mathematical computations based on a given description of a chemical process.

Specific objectives:

In class and without references, the student will...

(1) write short answers which identify, complete, or answer twelve phrases or questions concerning water and solutions. (83.33%)

(2) answer two questions which require mathematical computations involving concentration and/or dilution of solutions. (100%)

LESSONS 10, 11 and 12

Specific objective:

In class and without references, given five pH's, the student will indicate in writing whether a solution of each pH is strongly or weakly acidic or basic. (80%)

LESSONS 13-17

Specific objectives:

In class and without references, the student will correctly...

(1) match 21 representative organic structural formulas with their generic names. (85%)

(2) supply the names and formulas for six selected saturated hydrocarbons indicated by number of carbon atoms and the names only for their corresponding radicals. (83.33%)

(3) write two representative organic chemical equations selected from the four reactions studied. (100%)

(4) fill in the blanks in order to complete a skeleton paragraph dealing with organic chemistry. Nine answers required, seven correct to pass.

(5) select the best choice of five responses offered for each of ten multiple choice exercises. (80%)

LESSON 18

Specific objectives:

In class and without references, the student will...

(1) fill in six out of seven blanks correctly in order to complete a skeleton paragraph descriptive of classification of sugars and tests performed upon them.

(2) select the best choice of five responses offered for each of five multiple choice exercises. (80%)

LESSONS 19 and 20

Specific objectives:

In class and without references, the student will...

(1) fill in ten out of thirteen blanks correctly for lipids and (b) fifteen out of twenty blanks correctly for proteins in order to complete two skeleton paragraphs descriptive of their respective topics.

(2) select the best choice of five responses offered for each of three multiple choice exercises for lipids and eight multiple choice exercises for proteins. (80%)

LESSON 21

Specific objective:

In class and without references, the student will correctly select the best of five responses offered for each of four multiple choice exercises dealing with enzymes. (75%)

LESSON 22

Specific objective:

In class and without references, the student will correctly select the best of five responses offered for each of four multiple choice exercises dealing with digestion. (75%)

LESSONS 23 and 24

Specific objective:

In class and without references, the student will correctly select the best of five responses offered for each of five multiple choice exercises dealing with metabolism.

LESSONS 25-27

Specific objective:

In class and without references, the student will select the best of five responses offered in each of nine multiple choice exercises dealing with body fluids. (77.77%)